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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/689,386	10/20/2003	Christo P. Bojkov	TI-35951	4156
23494	7590	11/30/2004	EXAMINER	
TEXAS INSTRUMENTS INCORPORATED P O BOX 655474, M/S 3999 DALLAS, TX 75265			PAREKH, NITIN	
			ART UNIT	PAPER NUMBER
			2811	

DATE MAILED: 11/30/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/689,386

Applicant(s)

BOJKOV ET AL.

Examiner

Nitin Parekh

Art Unit

2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 September 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-28 is/are pending in the application.
- 4a) Of the above claim(s) 23-28 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 02-03-04 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. Applicant's election without traverse of Embodiment I, claims 1-22 in Paper No. 3 is acknowledged.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-8, 10, 11, 18, 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over admitted prior art (APA) in view of Wang et al. (US Pat. 6782897).

Regarding claims 1-8, 10, 11 and 18, the APA (Fig. 2) discloses semiconductor device including a contact pad and circuit/interconnecting metallization (202 in Fig. 2) on the surface of an integrated circuit (IC) chip, comprising:

- the interconnecting metallization comprising copper
- a stack of protection layers (203/210 in Fig. 2) over the surface of the IC chip, the stack comprising a first inorganic layer (203 in Fig. 2) such as silicon nitride (SiN) and a polymer layer (210 in Fig. 2) on the inorganic layer, the polymer layer comprising a material such as benzocyclobutene (BCB) or polyimide

- the SiN having a thickness of about 1.0 microns and the polymer layer having a thickness in the range from about 3-10 microns
- a window in the stack of layers exposing the metallization on the IC chip
- a patterned bottom/seed metal layer (205 in Fig. 2) on the metallization in the window and on the stack of protection layers around the window, and a top/buffer metal layer (206 in Fig. 2) positioned on the bottom/seed metal layer, and
- a metal reflow element/solder (207 in Fig. 2) attached to the top/said buffer metal (Fig. 2; specification pp. 9 and 10).

The APA fails to teach the stack of protection layers including a second inorganic layer on the polymer layer.

Wang et al. teach using a stack of passivation/protection layer system (32 in Fig. 3E) in an underbump metallization (UBM) structure (34A/34B in Fig. 3E) where the stack/system having a plurality of layers includes a polymer layer and one or more layers of an inorganic material such as SiN (see Col. 4, lines 49-53; Col. 4-6), the system providing improved passivation and adhesion/bonding of the UBM layers.

The APA further teaches using the inorganic layer/SiN having the thickness of about 1.0 microns (specification pp. 9 and 10).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the stack of protection layers including a second inorganic layer on the polymer layer as taught by Wang et al. so that the passivation

and the adhesion/bonding can be improved, and delamination and stress can be reduced in the APA's device.

Regarding claims 20 and 21, the APA and Wang et al. teach substantially the entire claimed structure as applied to claim 1 above.

4. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over the APA and Wang et al. (US Pat. 6782897) as applied to claim 1 above, and further in view of Kim et al. (US Pat. 6417089).

Regarding claim 9, the APA and Wang et al. teach substantially the entire claimed structure as applied to claim 1 above, except second protection layer being an inorganic layer comprising silicon dioxide.

Kim et al. teach an UBM structure having a protection/passivation layer wherein the protection/passivation layer is a conventional oxide/silicon dioxide or a nitride/SiN (Col. 4, line 54).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the second protection layer being an inorganic layer comprising silicon dioxide as taught by Kim et al. so that the desired dielectric properties can be achieved and processing can be simplified in Wang et al. and the APA's device.

5. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over the APA and Wang et al. (US Pat. 6782897) as applied to claim 1 above, and further in view of Shimizu et al. (US Pat. Application Pub. 2002/0043723).

Regarding claim 13, the APA and Wang et al. teach substantially the entire claimed structure as applied to claim 1 above, wherein the APA discloses the seed metal overlapping the top protection layer (see Fig. 2), but fail to teach the seed metal overlapping the second inorganic layer by about 5-15 microns.

Shimizu et al. teach an UBM structure (Fig. 1; sections 0090-0109) having protection/passivation layers and a bonding pad to provide the desired stress relief (8/10 and 12/14 respectively in Fig. 1), wherein the dimensions of the UBM/bonding pad structure are such that the protection/passivation layer opening at the top (see 11 in Fig. 1; section 0109) is about 10 microns wide and the bonding pad (see 12/14 in Fig. 1; section 0105) is 35 microns wide in a direction parallel to a substrate. Such configuration yields an overlap of the bonding pad/metallization being about 12.5 microns.

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the seed metal overlapping the second inorganic layer by about 5-15 microns as taught by Shimizu et al. so that the stress can be reduced and the reliability can be improved in Wang et al. and the APA's device.

6. Claims 12 and 14-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over the APA and Wang et al. (US Pat. 6782897) as applied to claim 1 above, and further in view of Hsuan et al. (US Pat. 6166444) and Akram (US Pat. 5736456).

Regarding claims 12 and 14-17, the APA and Wang et al. teach substantially the entire claimed structure as applied to claim 1 above, except:

- a) the seed metal comprises copper or the buffer metal comprises a single metal layer of copper or a copper alloy, or
- b) the buffer metal comprises a stack of metal layers, the stack comprises copper in contact with the seed metal, nickel on top of the copper, and palladium as outermost metal.

Hsuan et al. teach a chip module having an UBM structure (54 in Fig. 3) where the UBM has a single metal layer or a combination/stack of layers (see 50/52/54 in Fig. 3) including a bottom/barrier/seed layer and a top/coated layer to provide the desired adhesion and diffusion barrier (Col. 3, lines 1-45). Such combination/stack comprise a single layer/alloy or a combinations thereof, including the metals such as copper, nickel and palladium (Col. 3, lines 30-44 and lines 1-45).

Akram teaches an UBM structure (28/30/32 in Fig. 1h) where the UBM has four metal layers, the metals comprising chromium, copper, nickel and palladium where the outermost layer can be formed of palladium to improve soldering (Col. 2, lines 25-41).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the elements a) and b) as taught by Hsuan et al. and Akram so that the adhesion, diffusion barrier and reliability can be improved in Wang et al. and the APA's device.

6. Claims 19 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over the APA and Wang et al. (US Pat. 6782897) as applied to claim 1 above, and further in view of Moyer et al. (US Pat. 6620720).

Regarding claims 19 and 22, the APA and Wang et al. teach substantially the entire claimed structure as applied to claims 1 and 20 respectively above, except a bond wire being attached to the buffer metal.

Moyer et al. teach a conventional bonding wire (see 41 in Fig. 6A) being attached to a top/buffer metal layer in an UBM structure (Col. 4).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the bond wire being attached to the buffer metal as taught by Moyer et al. so that the wire bonding capability can be achieved in Wang et al. and the APA's device

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nitin Parekh whose telephone number is 571-272-1663. The examiner can normally be reached on 09:00AM-05:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9318.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

NP

11-24-04



NITIN PAREKH

PATENT EXAMINER

Technology Center 2800